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ALTERNARIA BLIGHT OF SESAME [1]

by
D. G. ZACHOS and C. G. PANAGOPOULOS

Early in July 1959 we had the opportunity to examine in the fields of Copais area sesame plants presenting a serious spotting caused by a species of *Alternaria*. The same disease was observed in the district of Cavala next year.

Since the disease is observed for the first time in Greece and because of the known variability of the pathogen, we give below the symptoms observed and a description of the causal agent.

SYMPTOMS

Angular spots delimited by the veins, 1-5 mm in diameter, appear on the leaves. They are brown in the edges, light brown at the central part and in the upper surface of the leaf they are surrounded by a yellow halo about one millimeter wide (Fig. 1, left). Many spots coalescing cover larger parts of the leaf blade. Occasionally the spots are elongated occupying and following the veins (Fig. 1, right).

Similar spots occur on the petioles. They are elongated 0,5-1 mm wide and 1-20 mm long and of the same colour.

On the stems, the spots are depressed and brown becoming lighter in the center. They form small dots but usually are elongated up to 20 mm long. When they join with one another form streaks along the stem.

Primary infections of the capsules appear as brown dots with a lighter center.

[1] Received for publication March 18, 1961.

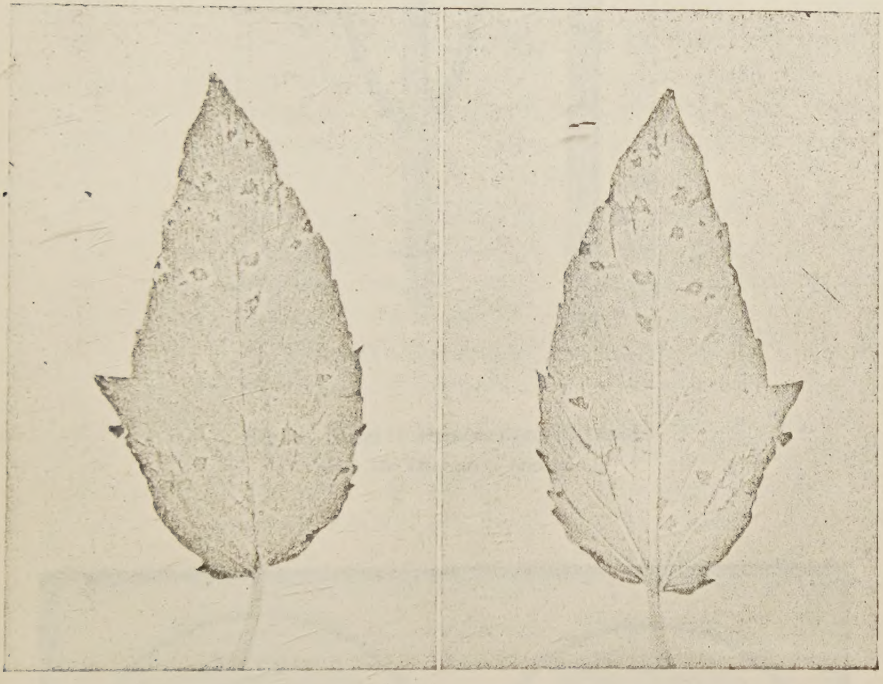


Fig. 1. Leaves of sesame showing spots due to *Alternaria sesami*. Left, upper surface of the leaf. Right, lower surface.

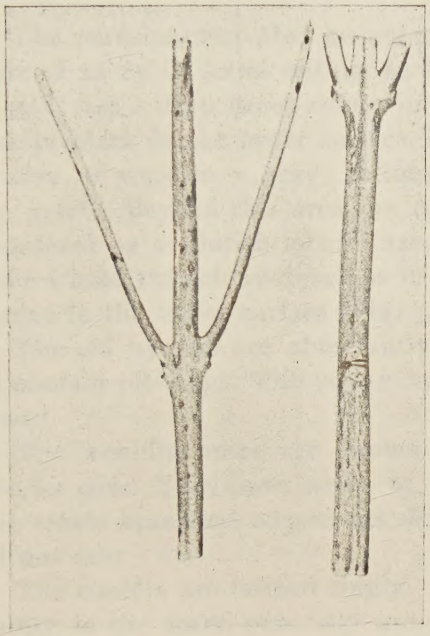


Fig. 2. Stem of sesame showing spots due to *Alternaria sesami*.

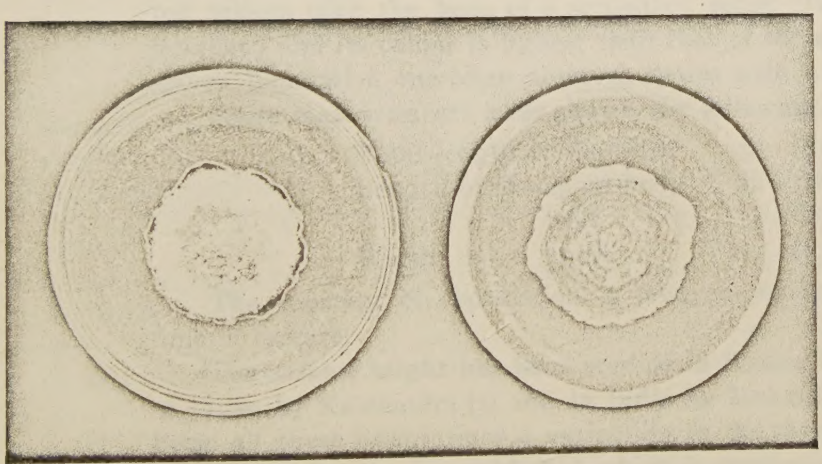
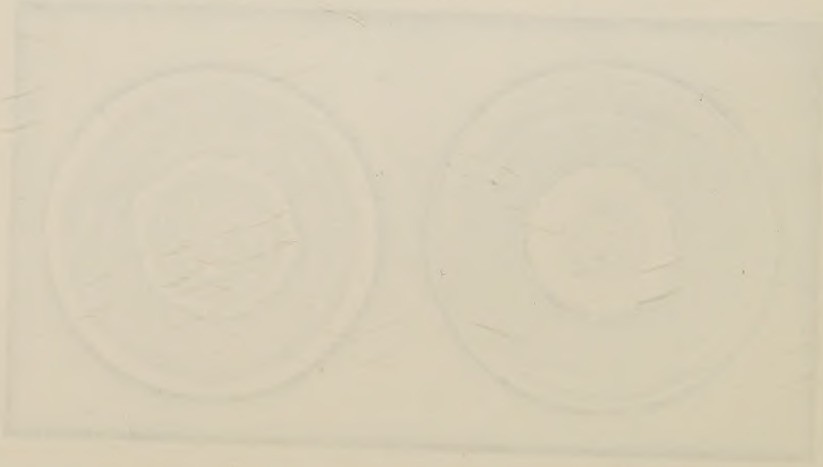


Fig. 3. Culture of *Alternaria sesami*, 11 days old. Left, upper surface of the culture. Right, lower surface.



DESCRIPTION OF THE FUNGUS

The parasite cultivated on potato-dextrose-agar, at the temperature of 22-23° C, forms within 10 days a colony of 4,5-5 cm in diameter. It has a deep green colour in the upper and deep blue, gray-black or black in the lower surface. In the central part of it and in an area of 3-3,5 cm. a gray, cottony, areal mycelium is developed (Fig. 3, left). Beyond this area the colony becomes velvety and then is bordered by a whitish lobate margin one to two millimeters wide. In the whole, the colony develops in concentric rings and this is better seen in the lower surface (Fig. 3, right).

The old hyphae are abundantly branched, septate, 3-6,5 μ wide, and contain oil drops. The young hyphae are hyaline becoming later brown.

The conidiophores are brown olivaceous 51-177 μ long and 4,4-6,8 μ wide. They have septa at distances 6,8-34 μ, and they are erect, rarely branched, sometimes slightly swollen terminally and present one scar.

The conidia are formed singly. Although they show a wide variability in the form, generally are smooth, elongated or oval, constricted by septa and beaked in a high percentage. Their colour is buffy brown or olive brown and have 4-13 transversal and 6-8 longitudinal septa. The spore body turns abruptly into a long filiform beak occasionally swollen terminally. The swollen apex of the beak may but seldom take the form of a secondary spore. The beak is rarely branched and its colour is lighter than that of the spore body. In the spores' population one often observes spores with a false beak.

Spore measurements have shown the following dimensions in μ:

Total length of the spore	34 - 183
Length of the spore body	22 - 78
» » » beak	3 - 129
Width » » spore	8,5 - 25,5

The capacity of sporulation is lowered markedly after a short time of culture.

The sesame blight has been studied in Russia by Kvashnina (4), in Japan by Kawamura (3) and in India by Mohanty and Behera (5). From all these descriptions a variability in the morphological characters of the fungus is established which is emphasized in Berry's detailed work (1, 2).

The cultural characteristics of our parasite are identical with those mentioned by the latter author. As to the morphological characters the measures fall among the extreme values given by the above mentioned authors. Some differences observed might be attributed to the known variability of the fungus. The inability, on the other hand, for the *Alternaria* isolated by us from sesame to infect *Zinnia* plants, as this has been confirmed by many artificial inoculations, excludes the species *Alternaria zinniae* Pape, the morphological characters of which,according to Neergard's description (6) approach those of our parasite.

We therefore consider that the *Alternaria* which caused the sesame blight belongs to the species *Alternaria sesami* (Kawamura) Mohanty and Behera.

As to the transmission of the disease, it seems that the use of infected seed greatly contributes to this. Seed taken from infected plants and examined in the laboratory has shown a large percentage of infection. In connection with this, Thomas (7) has successfully controlled damping-off and early attacks of seedlings caused by the above parasite by disinfecting the seed with the fungicide Orthocide 50.

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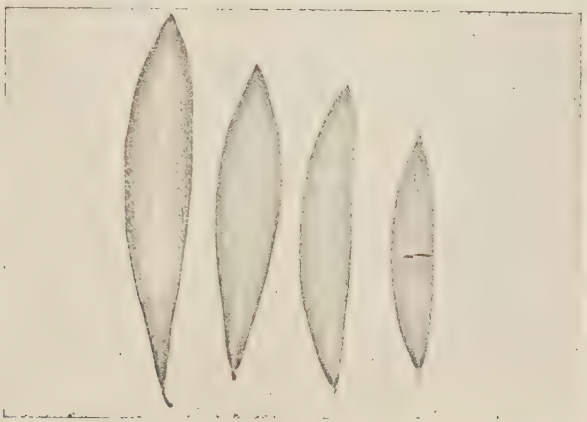

Fig. 1. Olive leaves showing symptoms not caused by boron deficiency. Normal leaf on the left. Galata area, Hania County. (See details in the text).

Fig. 2. Same as in Fig. 1. Neapolis area, Lasithion County.

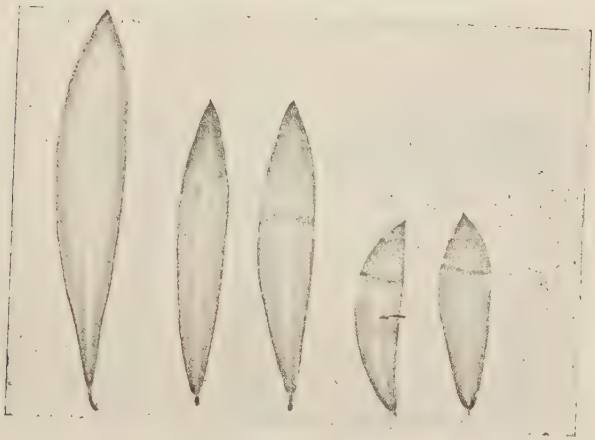

Fig. 3. Same as in Fig. 1.

Fig. 4. Characteristic chlorosis of the terminal part of olive leaves caused by boron deficiency. Leonidion area of Kynouria.

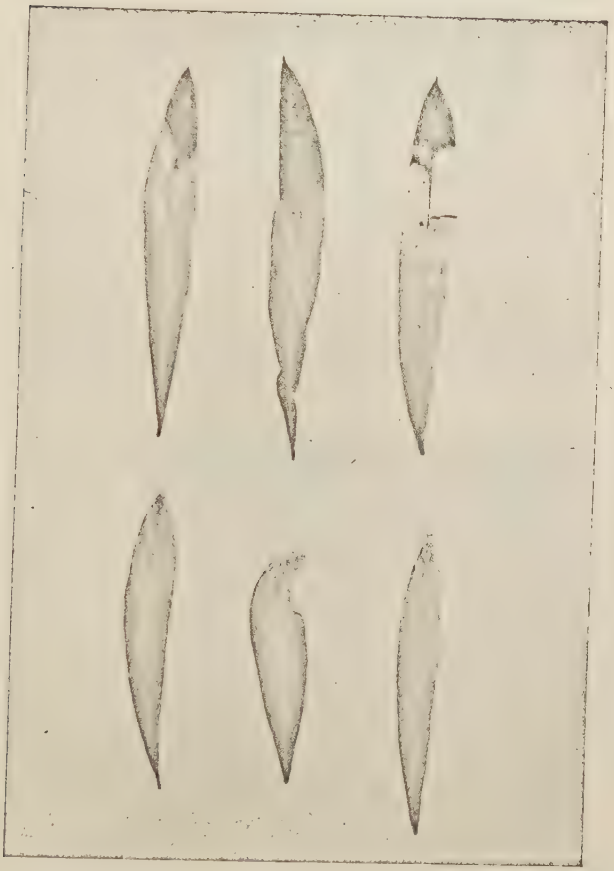

Fig. 5. Olive leaves showing chlorosis and necrotic tips caused by boron deficiency. Nydrion area, Leucas island.

S. D. Démétriadès and N. A. Gavalas : *Boron status of olive trees in relation to disease symptoms. A survey of Greek olive growing areas.*

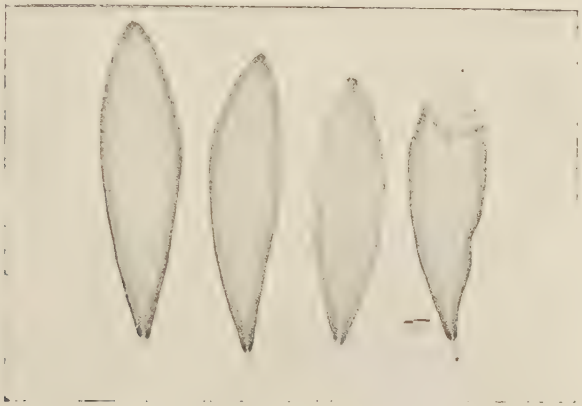

Fig. 6. Successive stages of chlorosis on olive leaves. This chlorosis is not due to boron deficiency. Nydrion area, Leucas island.

Fig. 7. Withered twigs on olive tree. A common symptom in many olive-growing areas, not caused in every case by boron deficiency.

Fig. 8. Necrotic spots in the bark of an olive branch.

Ann. Inst. Phytopath. Benaki, N.S., 3 : 184-214, 1961.

BORON STATUS OF OLIVE TREES IN RELATION TO DISEASE SYMPTOMS. A SURVEY OF GREEK OLIVE-GROWING AREAS[1, 2]

by

S. D. DÉMÉTRIADÈS and N. A. GAVALAS

For a number of years and in many olive-growing areas of Greece there have been noticed some disease symptoms which might be attributed, in addition to other causes, to malnutrition.

These disorders have caused some concern among olive-growers and have also drawn the attention of the Phytopathological Service of the Ministry of Agriculture, as well as the Benaki Phytopathological Institute.

The causes of these pathological conditions seem to be various. The fungus *Verticillium albo-atrum* Reinke et Berth. has been repeatedly isolated from diseased olive trees by the Mycological Laboratory of the Benaki Phytopathological Institute (5, 6, 7, 17) and this hadromycosis, as noticed recently (19), appears to be a serious and continuously extending disease of the olive tree.

On the other hand, *Phloeotribus scarabaeoides* Bern and *Hylesinus oleiperda* B. have been, for a long time, a serious cause of twig withering in certain areas (1, 13, 16).

Since many of the symptoms detected resemble those appearing in cases of nutritional disorders, it was considered interesting to examine whether lack of certain nutrient elements might be, directly or indirectly, related to such pathological conditions.

The olive tree seems to be sensitive to lack of boron; in addition, many of the symptoms noticed in the various districts were si-

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[2] This work has been financially supported by The Royal Hellenic Research Foundation and the Ministry of Agriculture within the program of research on olive pests and diseases.

milar to those of boron deficiency. Consequently, it was considered useful to investigate, at first, the possible relation between the above mentioned pathological conditions and boron deficiency. This nutritional disorder has already been observed widespread in olive groves of Lesbos island (3).

It must be noted that, in the field, only boron, potassium and nitrogen deficiencies have been observed in the olive, as far as we know. Boron deficiency has been noticed in California (18), Italy (2) and Greece (3). Potassium and nitrogen deficiencies have been conclusively reported only from California*.

To determine the boron status of olive trees, leaf samples were collected from the main olive-growing districts (Crete, Peloponnese, Zakynthos, Cephalonia, Leucas, Corfou, Prevesa, Aetolia, Acarnania, Phthiotis, Phokis, Pelion, Euboea and Attica). Sampled trees were closely examined and the observed symptoms were recorded.

This work was done mainly in June and July 1960 (see Tables I-XXI). The lower mature leaves of the current season's growth were collected. Leaves of the previous year's growth were taken if they showed any symptoms, or where the new growth was sparse or delayed. In some cases leaves of both the current and the previous year's growth were taken separately. Apparently healthy olive trees were also sampled.

Leaf analysis data of samples taken in spring 1961, in cases where boron deficiency was easily identified by symptoms, are presented in Table XXII.

As it was impossible to cover the above mentioned olive growing districts in the whole, this work was limited to areas where the Agricultural Extension Services had noticed symptoms of uknown origin, on olive trees.

SYMPTOMS

The various symptoms observed on sampled olive trees are described below. However, it must be noted again that they are not considered as characteristic manifestations of one definite disease but rather as pathological expressions of apparently different disorders.

* Potassium deficiency in olive has been reported by Hartmann (10) and by Hartmann and Brown (12) from California (Butte County) but a full description of this disorder is lacking. Hartmann (11) has also reported nitrogen deficiency in the same area following high rainfall in spring.

Consequently, the description of these symptoms is necessary only to help considering them in relation to leaf boron content.

Leaf symptoms.

The observed leaf symptoms can be classified into the following groups:

a) Chlorosis appearing at first on the leaf apex and gradually extending to the whole blade which eventually becomes copper-yellow in colour (Fig. 1 and 2). Usually tip necrosis follows, covering 1/3-2/3 of the blade (Fig. 2 and 3). These symptoms appear first on lower leaves on the whole of the foliage, or more usually on one or two of the main branches. Often, leaves on the most affected branches remain very small (Fig. 2 and 3). The leaves of the year's growth were free from such symptoms at sampling time (June - July).

The above leaf discolouration, along with various other symptoms, (twig withering, restricted growth, «witches' brooms») form a characteristic syndrome observed on a large number of trees in certain districts or on individual olive trees in other groves.

Although some symptoms of this syndrome are more or less similar to those of boron deficiency, leaf analysis showed that it was not a case of this nutritional disorder.

b) Chlorosis covering the 1/3 - 2/3 of the apical portion of the leaves (Fig. 4 and 5). This chlorosis was more pronounced on the upper leaves and, at the time of sampling, it was apparent on the leaves of the new growth. Tip necrosis was also noticed in some cases on a few leaves (Fig. 5). This is the typical chlorosis of boron deficiency as described in a previous work (3). In the Tables, leaf symptoms under (a) and (b) are referred to as «Symptoms on old leaves».

c) Necrosis of leaf tip with or without chlorotic zone below the withered tissues. This symptom appears in a limited number of old leaves and usually it is coupled with sudden dieback of branches and/or bark necrosis on trunk and main branches*. In the Tables this leaf symptom is referred to as «Symptoms on a few old leaves».

d) In some cases, chlorotic symptoms cannot be classified into any of the above three groups. Chlorosis appears also on the leaf tip and eventually extends to the whole blade (Fig. 6). In the final stage

* A somewhat different case is encountered in Neapolis area of Laconia County, where on a large number of olive trees, sudden dieback of branches occurs. Symptoms of (c) group are observed on leaves all over the foliage.

of the disease, affected leaves are much alike senile ones. This kind of chlorosis appears first on lower leaves. Later on, a pronounced defoliation follows.

Samples of leaves with symptoms of (d) group are No 9 and 10 in Table XIV, No 10 in Table VI and No 15 in Table XIX.

Symptoms on trunk, branches and twigs.

Symptoms on trunk, branches and twigs can be classified into the following two groups:

a) Progressive withering of twigs all over the tree foliage (Fig. 7); defoliation precedes this stage. Twig withering is in some cases connected with certain leaf symptoms [See Leaf symptoms (a)]. In some other cases, however, this withering seems to be the consequence of restricted growth and of the gradual weakening of the trees. In the Tables this symptom is referred to as «Withered twigs».

b) Sudden dieback of large branches with their leaves persisting. The growth of such branches was apparently normal, up to the time of dieback. In the Tables this symptom is referred to as «Branch dieback». In certain cases, branch dieback is linked with extended bark necrosis, localized overgrowths of bark, and long cracks on trunk and main branches. In the most severe cases the bark is split off in long strips and wood is revealed. The above syndrome has been observed on several areas, such as Elis County (Vounagros), Zakynthos, Agrinion, Amphissa, Itea, Stylis, Magnesia County (Korope) and Euboea. In severe cases, affected olive trees die in a few years. Sometimes, certain symptoms can be traced on a few old leaves on affected trees. [See Leaf symptoms (c)].

Apart from the above characteristic cases, there was also observed dieback of branches while the trees were free from any other symptoms.

Since necrotic spots in the bark of branches have been reported (2, 18) to be a characteristic symptom of boron deficiency, all sampled trees were examined for the presence or absence of such necrotic spots, in order to find whether or not there is any relation between this symptom (Fig. 8) and boron deficiency.

Crop production.

Leaf samples were also taken from areas where unfruitfulness has been observed for many years because of flower drop, fruit drop

or total absence of flowering [Nydrion (Leucas island), Astros (Peloponnese) and Argalaste (Magnesia County)].

LEAF ANALYSIS

The quinalizarine method as modified by Mc Dougall and Biggs (14) was used to determine the boron content of leaves. Results were judged on the basis of values found by Haas (8) and Hansen (9), as well as those obtained from the study of boron deficiency in olive groves of Lesbos islands (3). According to these data, in cases of boron deficiency, the boron content of olive leaves drops under 14 p.p.m. in dry matter, whereas in normal trees it is over 19 p.p.m. Olive trees with a leaf boron content ranging from 14 to 19 p.p.m. are considered to be in a transitional condition and they may show mild symptoms (particularly at 15 16 p.p.m.) or they may react positively to boron treatment though they show no apparent symptoms.

Results of leaf analysis are given in Tables I-XXII.

CONCLUSIONS

According to leaf analysis data, symptoms on olive trees, in some localities of the following areas, were due to boron deficiency:

1. Nea Tiryns, Nauplion (Table X, samples No 59, 59a, 60 and 60a).
2. Aghii Theodori, Corinthia (Table XI, samples No 90, 90a, 91 and 92).
3. Palaeocatouna, Nydrion, Leucas island (Table XIV, samples No 12, 12b, 13, 13b, 14 and 14b).
4. Prevesa (Table XVI, samples No 1, 2 and 8).
5. Nea Peramos and Megara, Attica (Table XXII, samples No 4, 5, 6, 7).
5. Leonidion, Cynouria (Table XXII, samples No 1, 2 and 3).
7. Rovies, Euboea (Table XXII, samples No 8 and 9).

Symptoms in the above cases were similar to those described in a previous work (3).

Low boron content, though above the threshold value for the appearance of symptoms, was found in olive trees in some localities of the following areas:

1. Vamvacopoulon, Chania (Table I, samples No 1 and 2).
2. Galatas, Chania (Table I, samples No 3, 4 and 6).
3. Sychaena, Achaia (Table V, samples No 1 and 2).

4. Amalias, Elis (Table VI, samples No 15 and 16).
5. Aspropoulia, Messenia (Table VII, samples No 21a, 22, 22a and 25).
6. Prevesa (Table XVI, samples No 3, 4, 6 and 7).
7. Mandra, Attica (Table XVIII, samples No 10 and 12).
8. Megara, Attica (Table XVIII, samples No 16 and 18).
9. Kinetta, Attica (Table XVIII, samples No 22 and 22a) and in individual olive trees in some other localities.

It must be noted that in some cases the leaves of the previous year's growth had a boron content near the threshold value of boron deficiency, whereas the leaves of the new growth of the same trees had a normal boron content (Table I, samples No 2-2a. Table II, samples No 41-41a. Table IV, samples No 55-55a. Table VII, samples No 30-30a). Obviously the decrease in boron content of old leaves in such cases is not due to lack of this element in the soil. On the contrary, in cases of boron deficiency, new leaves had a lower boron content than the leaves of the previous year's growth. (Table X, samples No 59-59a. Table XI, samples No 90-90a. Table XIV, samples No 12-12b, 13-13b and 14-14b). It is evident that in order to obtain reliable data for the determination of boron status of olive trees, mature leaves of the new growth must be sampled.

From the results of leaf analysis obtained so far, it is inferred that certain «diseases» of olive trees having some similarities to boron deficiency are not due to lack of boron. Nor can boron deficiency be the cause of unfruitfulness of olive trees in the areas of Nydrion (Leucas), Astros (Peloponnese) and Argalaste (Magnesia County).

It is also inferred that the diagnosis of boron deficiency in olive trees must always be based on leaf analysis, since symptoms on leaves, twigs and branches resembling those of boron deficiency, have been found, which, nevertheless, are due to other causes. It is also known that leaf symptoms of magnesium deficiency (12, 15), calcium deficiency (8, 15) and abnormal Ca/Mg ratio (4) in olive trees, are more or less similar to those of boron deficiency.

It has already been mentioned that the presence of necrotic spots in the bark has been considered as a characteristic symptom of boron deficiency (2, 18). By examining all of the sampled olive trees, we found that such necrotic spots, in the bark of large branches, are common in olive trees, both in cases of boron deficiency and in cases where this element is not lacking. This is clearly shown in the Tables of the present work. So, it is concluded that there is no relation bet-

ween the presence of such necrotic spots in the bark and boron content of leaves. It is true that necrotic spots are generally found in the bark of boron deficient olive trees, but their presence does not in every case mean that this element is lacking.

SUMMARY

Boron content of olive leaves was determined in a large number of samples collected from the main olive-growing areas of Greece. The idea was to find if there is any relation between boron deficiency and certain abnormalities of unknown origin.

Boron deficiency was found to exist in seven localities, and a low boron content was determined in many others.

From the data obtained, there were also inferred the following:

a) To obtain reliable data for the determination of boron status of olive trees by leaf analysis, young mature leaves must be sampled.

b) The diagnosis of boron deficiency in olive trees must always be based on leaf analysis because of certain similarities in symptomatology between this deficiency and other disorders.

c) Several olive tree disorders in Greece, of unknown yet cause, including some cases of flower-drop and unfruitfulness, are not due to lack of boron.

d) The presence of necrotic spots in the bark of large branches is not necessarily related to boron deficiency as was considered to be the case until now.

*

We wish to express our sincere thanks to the Directors of Agriculture of olive growing Counties mentioned for the information and facilities offered during the course of this investigation.

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TABLES

Boron content of olive leaves. Samples collected from various districts of Greece

Explanations of symbols used

O = Leaves of the past year's growth (old) without symptoms

O* = Leaves of the past year's growth with symptoms

N = New leaves without symptoms

N* = New leaves with symptoms

(c) = Composite sample

— Sample number with the letter **a** means that the sample consisted of the lower leaves of the new growth, collected from the same tree as the previous sample of the same number.

— Sample number with the letter **b** means that the sample consisted of the upper leaves of the new growth, collected from the same tree as the previous sample of the same number.

TABLE I

CRETE

Chania County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
1	Vamvacopoulon	1-6-60	Branch die-back	N	14.5
2	»	»	Symptoms on old leaves	O*	14.5
2a	»	»	»	N	20.0
3	Galatas	»	Symptoms on old leaves, little leaves, withered twigs, spots in the bark, low productivity	O*	16.0
4	»	»	»	O*	17.5
5	»	»	»	O*	18.5
6	»	»	»	O*	17.0
7	»	»	»	O*	18.5
8	»	»	»	O*	19.5
9	»	»	»	N	37.0
10	»	»	Without symptoms	N	23.5
11	Perivolia	»	Symptoms on old leaves, withered twigs, spots in the bark	O*	17.5
12	»	»	»	O*	19.0
13	»	»	»	O*	18.5
13a	»	»	»	N	31.0
15	Calyves	2-6-60	Symptoms on old leaves, little leaves, withered twigs	O*	23.5
15a	»	»	»	N	32.0
16	»	»	»	O*	20.5
17	»	»	»	O*	17.0
20	»	»	Withered twigs, spots in the bark	N	18.5
21	»	»	»	N	29.5
22	»	»	»	N	25.5
23	»	»	Spots in the bark	N	30.0
24	»	»	»	N	21.5

TABLE II

CRETE

Rethymnon County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
28	Prines	3-6-60	Symptoms on old leaves, little leaves, withered twigs	O*	20.5
29	»	»	»	O*	19.0
30	»	»	»	O*	21.5
30a	»	»	»	N	32.0
31	»	»	Fruit drop	N	20.5
33	Micri Gonia	»	Symptoms on old leaves, little leaves	O*	17.5
34	»	»	»	O*	22.5
34a	»	»	»	N	23.0
35	»	»	Without symptoms	N	22.5
36	Villantredo	»	»	N	22.0
37	»	»	Symptoms on old leaves, withered twigs	O*	25.5
38	»	»	»	N	21.5
39	»	»	»	N	17.5
40	»	»	Spots in the bark	N	26.5
41	Myrthios	»	Symptoms on old leaves, spots in the bark	O*(c)	13.5
41a	»	»	»	N(c)	20.0
42	»	»	»	O*	17.5
42a	»	»	»	N	25.0

TABLE III

CRETE

Heraclion County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
44	Archanes	4-6-60	Without symptoms	N	22.5
45	»	»	»	N	23.0
46	»	»	»	N	24.5
47	Mochos	5-6-60	Symptoms on old leaves, little leaves, withered twigs, spots in the bark	O*	20.5
48	»	»	»	O*	20.5
48a	»	»	»	N	26.5
49	»	»	Without symptoms	N	25.0
50	»	»	Symptoms on old leaves, whithered twigs, spots in the bark	O*	23.0
51	»	»	Symptoms on old leaves, little leaves, withered twigs, spots in the bark	O*	19.5
52	»	»	»	O*	19.5
53	»	»	»	O*	23.0

TABLE IV

CRETE

Lasethion County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
55	Critsa	7-6-60	Symptoms on a few old leaves, withered twigs, spots in the bark	O*	15.0
55a	»	»	»	N	24.5
56	»	»	Symptoms on a few old leaves, spots in the bark	N	25.0
57	Calo Chorio	»	Without symptoms	N	28.0
58	»	»	»	N	24.5
59	»	»	»	N	36.0
60	»	»	»	N	34.0
61	Cavoussi	»	»	N	30.0
62	»	»	»	N	24.5
63	Ierapetra	»	»	N	27.0
64	»	»	»	N	28.5
65	»	»	Symptoms on a few old leaves	O*	34.0
65a	»	»	»	N	38.5
66	Neapolis	8-6-60	»	N	33.0
67	»	»	Symptoms on old leaves, little leaves, spots in the bark	O*	18.0
67a	»	»	»	N	22.5
68	Latsida	»	Spots in the bark	N	26.0
69	»	»	»	N	25.5
70	»	»	Without symptoms	N	28.5

TABLE V

PELOPONNESE

Achaia County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
1	Sychaena	13-6-60	Branch die-back, restricted growth	O	17.0
2	»	»	»	O	17.0
3	Eglycas	»	Withered twigs	N	29.0
4	»	»	»	N	26.5
5	»	»	»	N(c)	25.5
6	Lappa	14-6-60	Without symptoms	N	32.0
7	»	»	»	N	26.0
8	»	»	Symptoms on a few old leaves, withered twigs, spots in the bark	O*	19.5
8a	»	»	»	N	17.0
9	»	»	»	N(c)	24.0

TABLE VI

PELOPONNESE

Elis County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
10	Vounagros	14-6-60	Symptoms on old leaves, withered twigs	N	36.5
11	»	»	Branch die-back, spots in the bark, extended bark necrosis and cracking in the trunk	N	30.5
12	»	»	Symptoms on a few new leaves, spots in the bark	N*	26.5
13	»	»	Withered twigs, spots in the bark	N	32.0
14	»	»	»	N	30.0
15	Amalias	15-6-60	Without symptoms	N	17.5
16	»	»	Symptoms on a few old leaves, withered twigs, spots in the bark	N	17.5
17	Cardamas	»	Withered twigs, spots in the bark	N	34.5
18	Douneica	»	»	N	23.5
19	»	»	Spots in the bark, restricted growth	N	18.0
20	»	»	Spots in the bark	N	26.0

TABLE VII

PELOPONNESE

Messenia County

of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
1	Aspropoulia	16-6-60	Symptoms on old leaves, withered twigs, spots in the bark	O*	18.5
1a	»	»	»	N	17.5
2	»	»	»	O*	17.0
2a	»	»	»	N	17.5
3	»	»	»	N	23.0
4	»	»	»	O*(c)	19.5
5	»	»	Spots in the bark	N	15.0
6	Ariochori	»	Without symptoms	N	28.5
7	Callirroe	»	Symptoms on old leaves, withered twigs, spots in the bark	O*(c)	17.0
8	»	»	»	N	32.0
9	»	»	»	N	28.0
10	»	»	»	O*	12.5
10a	»	»	»	N	36.0

TABLE VIII

PELOPONNESE

Laconia County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
31	Aegiae	17-6-60	Without symptoms	N	34.5
32	Mavrovouni, Gythion	»	Spots in the bark	N	30.5
33	»	»	Symptoms on a few old leaves, spots in the bark	N	21.0
34	»	»	Symptoms on a few old leaves, withered twigs, spots in the bark	O*	18.0
34a	»	»	»	N	31.5
36	Tarapsa	18-6-60	»	N	25.5
37	»		»	N	32.0
38	»	»	Symptoms on a few old leaves, spots in the bark	N	32.5
42	Neapolis	»	Symptoms on old leaves, branch die-back, spots in the bark	O*	28.0
42a	»	»	»	N	40.5
43	»	»	»	O*	22.0
43a	»	»	»	N	35.5
44	»	»	»	O*	20.0
44a	»	»	»	N	22.0
45	»	»	»	O*	32.0
45a	»	»	»	N	30.5
78	Gythion	20-6 60	Branch die-back	O	17.5
78a	»	»	»	N	39.5
79	»	»	»	O	33.0
79a	»	»	»	N	36.0
80	»	»	»	O	21.0
80a	»	»	»	N	46.5

TABLE IX

PELOPONNESE

Arcadia County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
46	Astros	20-6-60	Flower drop	N	22.5
47	»	»	»	N	22.0
48	»	»	»	N	18.5
49	»	»	»	N	24.0
50	»	»	Without symptoms	N	26.5
51	»	»	»	N	18.5
84	Leonidion	1-7-60	?	N	33.0
85	»	»	Withered twigs	N	24.0
86	»	»	»	N	26.0

TABLE X

PELOPONNESE

Argonauplia County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
52	Polygona	21-6-60	Branch die-back	N	24.5
53	Areia	»	»	N	32.0
54	»	»	Branch die-back, spots in the bark	N	21.5
55	»	»	Symptoms on a few old leaves, spots in the bark	O*(c)	18.5
56	»	»	Little leaves, withered twigs, spots in the bark	N	25.5
57	Aghios Adrianos	»	Symptoms on a few old leaves, spots in the bark	N	17.5
58	Nea Tiryns	»	Symptoms on a few old leaves, withered twigs, spots in the bark	O*	23.5
58a	»	»	»	N	22.0
59	»	»	Symptoms on old and new leaves, withered twigs, spots in the bark	O*	15.5
59a	»	»	»	N*	10.0
60	»	»	»	II*	9.5
60a	»	»	»	N*	10.5
61	Aghia Trias	»	Symptoms in a few old leaves, spots in the bark	N	45.0
62	»	»	»	O*	22.0
62a	»	»	»	N	19.5
63	Panarite	»	Spots in the bark	N	36.0
64	»	»	»	N	29.0
65	Kephalarion, Argos	22-6-60	Branch die-back, spots in the bark	N	32.5
66	Kiveri	»	Symptoms in a few old leaves, branch die-back, spots in the bark	O*(c)	21.0
67	»	»	»	N(c)	21.5

TABLE XI

PELOPONNESE

Corinthia County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
68	Corinthos	22-6-60	Symptoms on a few old leaves, branch die back, spots in the bark	N	21,5
69	»	»	»	N	23,0
70	»	»	»	O*	19,5
70a	»	»	»	N	15,5
71	»	»	»	N	18,0
72	Chiliomodion	»	Spots in the bark	N	32,0
73	Aghios Vasilios	»	»	N	33,5
74	»	»	»	N	36,0
75	Derveni	23-6-60	Without symptoms	N	24,5
76	»	»	»	N	23,5
77	»	»	»	N	27,0
87	Aghii Theodori	28-6-60	Spots in the bark	N	19,0
88	»	»	Symptoms on a few old leaves, spots in the bark	N	24,5
89	»	»	Spots in the bark	N	32,0
90	»	»	Symptoms on old leaves, withered twigs, spots in the bark	O*	13,5
90a	»	»	»	N	10,5
91	»	»	»	N	13,5
92	»	»	»	N	13,5

TABLE XII

Zakynthos County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
1	Neratjoules, Argassion	2-7-60	Symptoms on a few old leaves, spots in the bark	N	21.5
2	»	»	»	N	20.5
3	»	»	»	O*(c)	17.5
4	»	»	»	O*	18.0
4a	»	»	»	N	23.5
5	»	»	Symptoms on a few old leaves, branch die-back, extented bark necrosis and cracking in the trunk, abnormal overgrowth of bark	N	30.0
6	»	»	»	N	19.0
7	»	»	Symptoms on a few old leaves, spots in the bark	O*(c)	23.5
7a	»	»	»	N(c)	33.0
8	Calyteron, Argassion	»	»	N	28.0
9	Lithakia	»	Symptoms on a few old leaves, branch die-back, spots in the bark	O*	28.0
9a	»	»	»	N	24.5
10	»	»	»	O*	21.0
10a	»	»	»	N	21.0
11	Machaeradon	»	Symptoms on old leaves, spots in the bark	O*	29.5
11a	»	»	»	N	21.0
12	»	»	»	O*	25.5
12a	»	»	»	N	20.0
13	Aghia Marina	»	Symptoms on old leaves, little leaves, withered twigs, spots in the bark	N	26.0
14	»	»	»	O*	21.0
15	»	»	»	O*	23.0
16	»	»	»	O*	23.0
16a	»	»	»	N	25.0
17	Lophos Strani	»	Spots in the bark	N	31.5

TABLE XIII

Cephalonia County

of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
	Courcoumelata	4 7-60	Symptoms on a few old leaves, spots in the bark	N	26.5
	»	»	»	O*	21.5
2a	»	»	»	N	35.5
3	Sarlata	»	One branch with all leaves yellow	N*	36.0
3a	»	»	Normal branches of No 3 tree	N	36.5
	»	»	Symptoms on a few old leaves, spots in the bark	N	42.0
	»	»	»	N	31.5
	»	»	»	O*	34.5
a	»	»	»	N	27.5
	Svoronata	»	»	$O^{*}_{(c)}$	25.0
	»	»	»	N	32.5
	»	»	Without symptoms	N	23.0
	»	»	»	N	23.5
	»	»	Symptoms on a few old leaves, spots in the bark	N	23.5
	Pharaclata	»	Without symptoms	N	24.5
	»	»	»	N	23.0
	»	»	»	N	29.5
	Rasato	»	Symptoms on a few old leaves, spots in the bark	$O^{*}_{(c)}$	21.5
	»	»	Spots in the bark	N	22.0
	»	»	»	N	22.5
	Argostoli	»	Without symptoms	N	19.5
	»	»	»	N	22.0
	»	»	Symptoms on old leaves	$O^{*}_{(c)}$	25.0
a	»	»	»	$N_{(c)}$	25.5

TABLE XIV

Leucas County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
2	Nydrion	10-7-60	Withered twigs, spots in the bark, flower drop	N	18.0
3	»	»	Symptoms on a few old leaves, spots in the bark, flower drop	N	25.0
4	»	»	Symptoms on a few old leaves, withered twigs, spots in the bark, flower drop	N	19.5
5	»	»	Symptoms on a few old leaves, spots in the bark, flower drop	N	22.0
6	»	»	Flower drop	N	28.5
7	»	»	Symptoms on a few old leaves, withered twigs, spots in the bark, flower drop	O*(c)	25.0
8	»	»	Spots in the bark, flower drop	N	29.0
9	Palaeocatouna, Nydrion	»	Symptoms on old leaves, spots in the bark	O*	20.0
9a	»	»	»	N	23.0
10	»	»	Symptoms on old leaves, little leaves, spots in the bark	O*	31.5
11	»	»	Symptoms on old leaves, spots in the bark	N	26.0
12	»	»	Symptoms on old and new leaves, branch die-back, spots in the bark	O*	15.5
12b	»	»	»	N*	8.5
13	»	»	»	O*	9.0
13b	»	»	»	N*	6.5
14	»	»	»	O*	10.0
14b	»	»	»	N*	7.0

TABLE XV

Corfou County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
1	Agros	7-7-60	Without symptoms	N	26.5
2	»	»	»	N	22.5
3	Messaria	»	Withered twigs, spots in the bark	N	23.0
4	»	»	Symptoms on a few old leaves, withered twigs, spots in the bark	O*	24.5
4a	»	»	»	N	25.0
5	»	»	Symptoms on a few old leaves	O*	26.5
5a	»	»	»	N	26.0
6	Velonades	»	Withered twigs, spots in the bark	N	19.5
7	»	»	»	N	19.0
8	»	»	Symptoms on a few old leaves, spots in the bark	N	21.0
9	»	»	Spots in the bark	N	23.0
0	»	»	Without symptoms	N	20.0
1	»	»	»	N	28.0
2	Castellani, Gyros	»	Symptoms on old leaves	N	24.5
3	Scripero	»	Without symptoms	N	25.5
4	»	»	»	N	20.5
5	»	»	»	N	25.5
6	»	»	»	N	20.0
9	Cavos	17-9-60	»	N	29.5
0	»	»	Symptoms on old leaves	O*	60.0
1	»	»	Without symptoms	N	22.5
4	»	»	Symptoms on old leaves	O*(c)	52.5
2	Lacos, Arcadades	»	Without symptoms	N	37.5
3	»	»	»	N	26.0
5	Nesaki	»	»	N	26.5
6	»	»	»	N	24.5
7	Aghios Athanassios	»	»	N	28.5
8	Argyrades	»	»	N	26.0

TABLE XVI

Prevesa County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
1	Aghios Georgios, Prevesa	9-7-60	Symptoms on old and new leaves, withered twigs, spots in the bark	N*	10.0
2	»	»	»	N*	9.5
3	»	»	Symptoms on a few new leaves, withered twigs, spots in the bark	N	17.5
4	Poros, Prevesa	»	»	N	17.0
5	»	»	Symptoms on old leaves, withered twigs, spots in the bark	N	24.0
6	Rache, Prevesa	»	»	O*	17.5
7	»	»	»	N	15.5
8	»	»	Symptoms on old leaves, little leaves, withered twigs, spots in the bark	O*	11.5

TABLE XVII

Aetolia and Acarnania County

of samples	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
	Agrinion	11-7-60	Branch die-back, spots and long cracks in the bark	N	18.0
	»	»	Withered twigs, spots in the bark	N	26.0
	»	»	Spots in the bark	N	49.0
	»	»	Branch die-back, spots and long cracks in the bark	N	23.5
	»	»	Spots in the bark	N	29.0
	»	»	»	N	28.5
	Panaetolion	12-7-60	Symptoms on a few old leaves, branch die-back, spots in the bark	O*	50.0
	»	»	»	O*	38.5
a	»	»	»	N	42.0
	»	»	»	O*	37.0
a	»	»	»	N	42.5
	»	»	Little leaves, branch die-back	N	25.5
	»	»	Branch die-back	N	32.5
	»	»	»	N	34.0
	»	»	Symptoms on a few old leaves, branch die-back	O*	48.5
a	»	»	»	N	34.5
	»	»	»	O*	42.0
	»	»	Little leaves, restricted growth, withered twigs, spots in the bark	N	20.0

TABLE XVIII

Attica County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. In dry matter
1	Aspropyrgos	28-6-60	Withered twigs	N	22.0
2	»	»	»	N	29.0
3	»	»	»	N	39.0
4	»	»	»	N	37.0
5	»	»	Symptoms on a few old leaves, spots in the bark	N	20.5
6	»	»	»	N	30.0
7	Mandra	»	Withered twigs	N	28.5
8	»	»	Without symptoms	N	31.5
9	»	»	»	N	29.0
10	»	»	»	N	16.5
11	»	»	Symptoms on a few old leaves, withered twigs, spots in the bark	O*	18.0
11a	»	»	»	N	22.0
12	»	»	Without symptoms	N	16.5
13	»	»	»	N	20.5
14	Megara	»	Symptoms on a few old leaves, withered twigs, spots in the bark	N	19.0
15	»	»	»	N	24.0
16	»	»	»	N	17.0
17	»	»	»	O*	20.0
17a	»	»	»	N	21.0
18	»	»	»	O*	17.0
19	»	»	Without symptoms	N	23.0
20	»	»	»	N	37.0
21	»	»	Withered twigs, spots in the bark	N	20.0
22	Kinetta	»	Symptoms on a few old leaves, spots in the bark	O*	17.0
22a	»	»	»	N	17.0

TABLE XIX

Phokis County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. In dry matter
1	Amphissa-Itea	19-7-60	Spots in the bark	N	45.5
2	»	»	Branch die-back, spots in the bark	N	35.0
3	»	»	»	N	32.0
4	»	»	Spots in the bark	N	49.0
5	»	»	Symptoms on a few old leaves, spots in the bark	N	44.5
6	»	»	Branch die-back, spots in the bark	N	44.0
7	»	»	Leaf marginal necrosis, spots in the bark	N *	82.0
8	Penteoria	»	Branch die-back, spots in the bark	O	28.0
8b	»	»	»	N	37.0
9	»	»	Symptoms on old leaves, spots in the bark	O *	28.5
9a	»	»	»	N	31.0
10	»	»	Branch die-back	N	22.5
11	»	»	Symptoms on a few old leaves, branch die-back	N	42.5
12	»	»	Spots in the bark	N	30.5
14	»	»	Little leaves, restricted growth	N	20.0
15	Monasterakion	20-7-60	Symptoms on the new leaves, local overgrowth of bark (tree 3-4 years old)	N *	27.0
16	»	»	Leaves with marginal discolouration (wild olive)	N	35.0
17	»	»	Branch die-back	N	34.0
18	»	»	Short internodes (wild olive)	N	20.5
19	»	»	Withering of shoot's apex	N	34.0

TABLE XXI

Magnesia County

No of sample	Location	Date of collection	Symptoms	Sampled leaves	B p.p.m. in dry matter
1	Ano Lechonia	25-7-60	Branch die-back, spots in the bark	N	33.5
2	»	»	Symptoms on a few old leaves, branch die-back, spots in the bark	N	31.0
3	Cato Gatjea	»	Branch die-back, spots in the bark	N	35.5
4	»	»	»	N	26.0
5	»	»	»	N	23.0
6	Malaki	»	»	N	39.5
7	Aphissos	»	»	N	26.0
8	Corope	»	»	N	24.5
9	»	»	Symptoms on a few old leaves, branch die-back, spots and cracking in the bark	O*	24.5
9a	»	»	»	N	25.5
10	»	»	»	N	45.5
11	»	»	»	N	31.5
12	»	»	»	N	30.0
13	»	»	Branch die-back, spots in the bark	N	24.5
15	Melina	»	Flower drop, spots in the bark	N	29.0
16	»	»	»	N	31.5
17	»	»	Symptoms on a few old leaves, flower drop, spots in the bark	O*	26.0
17a	»	»	»	N	31.5
18	»	»	Flower drop	N	27.5
19	»	»	»	N	24.5
20	Chorto	»	»	N	32.5
21	»	»	»	N	35.5
22	»	»	»	N	37.5
23	»	»	Flower drop, spots in the bark	N	50.0
24	»	»	»	N	34.5
25	Argalaste	»	Non fruiting	N	31.5
26	»	»	»	N	26.5
27	»	»	»	N	26.0
28	»	»	»	N	26.0
29	»	»	»	N	31.5

TABLE XXII

Boron content of olive leaves showing symptoms of boron deficiency
(Sampled in spring 1961 from various areas of Greece)

No	Location	Date of collection	Condition of tree	B p.p.m. in dry matter
1	Placa, Leonidion	22-3-61	Diseased	7.5
2	»	»	»	10.0
3	Leonidion	»	»	13.0
4	Nea Peramos	1-4-61	»	9.0
5	»	»	»	10.0
6	Megara	»	»	11.5
7	»	»	»	11.5
8	Rovies, Euboea	15-4-61	»	11.5
9	»	»	»	11.5